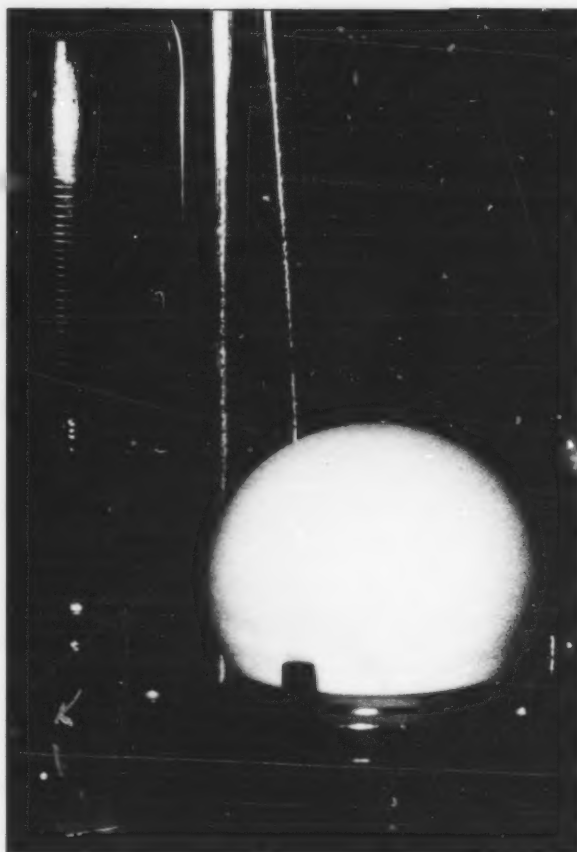




Canadian Grain
Commission

Commission canadienne
des grains



**Grain
Research
Laboratory**

**Quality of
Western
Canadian
Wheat
1991**

Canada



Quality of Western Canadian Wheat 1991

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Summary

After a bumper crop in 1990, the first two months of the 1991 growing season generally saw abundant rainfall and near-perfect conditions for plant growth. As a result, record high production of both spring and amber durum wheat and record yields of durum were achieved. A very dry and early harvest helped produce sound wheat of excellent grade and high falling number.

Because of the extremely high yields, protein content is lower this year: 13.4% for red spring wheat and 12.4% for amber durum wheat (0.2 and 1.2 percentage units below the respective long-term averages).

Milling and baking quality in 1991 is generally very good for all classes. Cooking quality of durum wheat is satisfactory despite the lower protein content, and semolina and spaghetti color are very good.

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Introduction

This bulletin presents detailed information on the quality of the 1991 crop of six classes of Canadian wheat offered on the world market:

Canada Western Red Spring Wheat: a hard wheat with superior milling and baking quality. It is offered at various guaranteed levels of protein content.

Canada Western Amber Durum Wheat: a durum wheat producing a high yield of semolina with excellent pasta-making quality.

Canada Western Red Winter Wheat: a hard wheat suitable for the production of a wide variety of products including French breads, flat breads, steamed breads and certain types of noodles.

Canada Prairie Spring Wheat: a semi-hard wheat with excellent milling quality, medium protein content and medium gluten strength. It is suitable for use in the production of hearth and flat breads, crackers, noodles and chapattis.

Canada Western Utility Wheat: a hard red spring wheat with extra-strong gluten suitable for blending purposes and for the production of hearth and pan breads.

Canada Western Soft White Spring Wheat: a soft wheat of medium-to-low protein content for production of various types of flat breads, noodles, steamed breads, chapattis, cookies, cakes and pastry.

It is important to note that data presented in this bulletin are not quality specifications for Canadian wheat. Rather, they represent the best estimate we can obtain in time for the Grain Research Laboratory to report at the end of October to the Committee on Western Grain Standards.

The extent to which the data in this bulletin indicate the exact quality characteristics of wheat of any given grade that will be exported during the coming year depends on a number of factors. These include: the amounts and relative quality of carryover stocks of each grade, and whether the harvest survey composites are, indeed, truly representative of the harvest production.

Statistics Canada (*Field Crop Reporting Series*, No. 6, September 6, 1991) estimates 1991 production of spring wheat in Western Canada at 27.0 million tonnes

(from 12.3 million hectares), compared with 26.5 million tonnes (from 11.7 million hectares) in 1990 and the ten-year (1980-89) average of 19.6 million tonnes (from 10.7 million hectares). Normally, over 95% of the spring wheat grown is of the Canada Western Red Spring class - with the Canada Western Utility, Canada Western Soft White Spring and Canada Prairie Spring classes making up the remainder.

Corresponding production estimates for durum wheat are as follows: a second consecutive record-high of 4.5 million tonnes (from 2.0 million hectares) for 1991, 4.3 million tonnes (from 2.1 million hectares) for 1990 and 2.9 million tonnes (from 1.8 million hectares) for the 10-year averages.

Production of red winter wheat is estimated this year to be 180 thousand tonnes (from 77 thousand hectares) - which is down substantially from last year's production of 299 thousand tonnes (from 154 thousand hectares). This is much below the 10-year average production of 446 thousand tonnes (from 249 thousand hectares) for this class of wheat.

On April 1, 1991, prairie wheat prospects were dismal after one of the driest fall and winter periods ever recorded. Subsoil moisture reserves were almost non-existent, which put yield expectations much below normal. However, a miraculous recovery occurred between mid-April and mid-July with widespread and abundant rainfall across the Prairies. Some stations reported precipitation in excess of twice the normal amount and yield expectations increased to record levels.

The wet conditions caused seeding delays in early May, but farmers managed to catch up in the last half of the month. Cool, wet conditions through June slowed crop growth and maturation was estimated to be almost a week behind normal in early July. However, dry conditions in the last half of July and heat in early August matured the wheat rapidly. This also reduced yield potential by stressing the crop during the critical filling stage. The late season dry spell dropped yields below average in eastern Manitoba and northeastern Alberta. Elsewhere, yields were excellent.

The dry weather in August provided ideal harvesting conditions. Into September, the weather turned cool and showery - which delayed harvesting. Toward the last week of September, warm and sunny conditions

returned, with the result that the wheat harvest was 95% complete by the end of the month.

Despite some of this deterioration in harvesting weather, the majority of hard red spring and durum wheat will grade No. 1 and No. 2 CW. In contrast, a major portion of the Canada Prairie Spring (CPS) wheat in the Red River Valley suffered heat stress during filling and a resultant loss in quality. Although later-received samples were better, the quality of CPS-Red wheat was poorer than normal.

Data from the 1991 protein content survey and from tests on grade composite samples of six classes of wheat are presented in the series of tables, figures and comments which now follow. Table 1 gives mean protein content values for wheat of each class reported. Details regarding the collection of samples and methods used to obtain the data are provided at the end of this bulletin.

Figure 1 shows the general wheat growing areas in Western Canada.

1. Protein Content of 1991 and 1990 Crop Canada Western (CW) and Canada Prairie Spring Wheat Classes

Wheat Class	Protein Content*	
	1991	1990
	%	%
CW Red Spring	13.4	13.6
CW Amber Durum	12.4	13.7
CW Red Winter	10.6	11.3
Canada Prairie Spring	11.3	N/A
CW Utility	12.9	12.7
CW Soft White Spring	10.6	10.9

* mean value, N x 5.7; 13.5% moisture content basis.

Figure 1. Map of Canada Showing Major Wheat Producing Areas in the Prairies



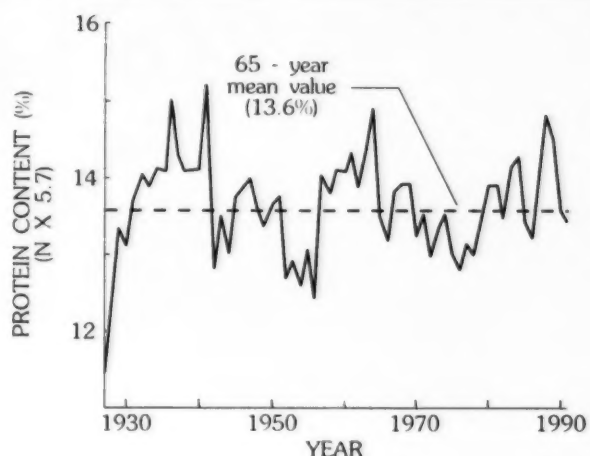
Canada Western Red Spring Wheat

Protein Survey

The average protein content of the 1991 red spring wheat crop is 13.4% - lower by 0.2 percentage units than both the 1990 and 65-year average values. This mean protein content estimate is based on 7,893 harvest survey samples tested this year. The protein content (13.4%) of the No. 1 CW grade is lower, by 0.9 percentage units, than the 1981-90 ten-year average of 14.3%, while the protein content of 13.3% for the No. 2 CW grade is correspondingly lower by 0.8 percentage units. Annual fluctuation in mean protein content since 1927 is given in Figure 2. Table 2 shows, for the No. 1 and No. 2 CW grades, mean protein content distribution by province and ten-year means (1981-90) for Western Canada.

This year, there is a substantial range in protein content between provinces: 0.8 percentage units for the No. 1 CW grade and 1.2 percentage units for the No. 2 CW grade. Manitoba values are the highest and Saskatchewan the lowest in both instances.

Figure 2. Mean Protein Content of Harvest Survey Western Canadian Red Spring Wheat 1927 to 1991



2. Protein Content of 1991 Harvest Survey Red Spring Wheat

Grade	Protein Content (%)*					
	Western Canada			1991		
	1991	1990	1981-90	Manitoba	Saskatchewan	Alberta
No. 1 CWRS	13.4	13.8	14.3	14.0	13.2	13.3
No. 2 CWRS	13.3	13.3	14.1	14.1	12.9	13.3

* N x 5.7; 13.5% moisture content basis.

Milling and Baking Quality - Allis-Chalmers Laboratory Mill

For quality assessment of the 1991 Canada Western Red Spring (CWRS) wheat crop, composites were prepared from over 5,000 harvest survey samples representing the top two milling grades. These grades are segregated into composite samples with minimum levels of protein content of 14.5, 13.5 and 12.5% for the No. 1 CW grade and 13.5 and 12.5% for the No. 2 CW grade. For each grade and segregate, one composite (rather than two) is now being used to represent samples from the Canadian Prairie wheat-growing area.

Because of changing shipping and marketing patterns, the traditional Eastern Prairie/Western Prairie split is no longer valid. This is borne out by close similarities in average quality for shipments of high grade CWRS wheat cargoes exported from Pacific and Atlantic positions. (See "A Review and Analysis of Export Cargo Quality Data for Canada Western Red Spring Wheat: 1973-1986" by K.R. Preston, B.C. Morgan and K.H. Tipples, *Can. Inst. Food Sci. Technol. J.* 21(5):520-530, 1988.)

No. 1 Canada Western Red Spring Wheat

Quality data for the No. 1 CWRS composites are given in Table 3. Corresponding data are provided for last year's composites, as well as 10-year (1980-89) averages for the No. 1 CW 13.5 segregate. Since single composites are now being used, the comparative 1990 and 10-year average data represent averages of the Eastern and Western Prairie No. 1 CW quality data reported in previous harvest survey bulletins.

Test weight and kernel weight are lower than last year. All composites show low levels of alpha-amylase activity and correspondingly high values for wheat falling number and flour amylograph peak viscosity. Wheat ash content is higher than for previous crops.

Milling quality (for Allis-Chalmers milled samples) is slightly inferior to that of last year - mainly due to higher flour ash values. Flour color is excellent, similar to last year. Pilot milling information is presented on pages 10 and 11.

Farinograph absorption is similar to 1990 and somewhat higher than long-term average values. Dough strength properties are within the range normally expected for top grade CWRS wheat flour.

Baking results for this year's No. 1 grade show high loaf volume per unit of flour protein and very good crumb and crust characteristics in the Remix-to-peak method. Baking absorptions are similar to 1990 and long-term average values. Additional baking quality information is presented on pages 10 and 11.

No. 2 Canada Western Red Spring Wheat

Quality characteristics for the No. 2 CWRS composites by protein segregate level, representing the overall prairie region, are shown in Table 4. Corresponding 1990 and 10-year average data (averages of Eastern and Western Prairie data previously reported) are also given.

Test weight and 1000 kernel weight are lower than 1990 values. Wheat falling number and flour amylograph peak viscosity values are high, indicating sound kernel characteristics. Milling properties are similar to last year, although flour ash is slightly higher.

Physical dough properties are stronger than in 1990, but within the range normally expected for higher grade CWRS wheat flour. Farinograph absorption values are lower than those of last year and similar to long-term averages.

Baking results (Remix-to-peak method) are very good - with high loaf volume per unit protein content and high scores for crumb and crust characteristics. Absorption is similar to last year.

3. NO. 1 CANADA WESTERN RED SPRING WHEAT
Quality Data for 1991 Harvest Survey Grade Composite Samples

Quality Parameter	Minimum Protein Level			No. 1 CW 13.5	
	14.5	13.5	12.5	1990	Mean*
WHEAT					
Test Weight, kg/hL	79.9	80.8	81.6	81.7	81.2
Weight per 1000 Kernels, g	30.2	30.9	31.1	32.2	30.1
Protein Content, % (N x 5.7)	14.7	13.8	12.8	13.8	13.8
Ash Content, %	1.65	1.61	1.59	1.43	1.57
Alpha-amylase Activity, units/g	5.1	4.4	4.5	4.4	3.7
Falling Number, s	400	400	405	395	400
Particle Size Index, %	49.0	48.1	47.2	51.7	N/A
MILLING					
Flour Yield					
Clean Wheat Basis, %	74.9	75.4	75.4	75.6	75.4
0.50% Ash Basis, %	74.9	75.4	75.4	76.1	76.4
-0.3 Flour Color Grade Basis, %	76.4	77.8	78.7	77.8	76.6
FLOUR					
Protein Content, %	14.2	13.1	12.2	13.2	13.2
Wet Gluten Content, %	42.2	39.2	35.3	39.5	39.3
Ash Content, %	0.50	0.50	0.50	0.49	0.48
Color, units	-0.8	-1.1	-1.4	-1.0	-0.7
Starch Damage, Farrand units	34	36	40	33	32
Alpha-amylase Activity, units/g	1.1	1.4	1.4	1.2	1.0
Amylograph Peak Viscosity, BU	710	700	695	705	720
Maltose Value, g/100 g	2.0	2.3	2.3	2.1	2.0
BAKING (Remix-to-Peak Method)					
Absorption, %	66	64	64	64	65
Remix Time, min	2.3	2.6	2.6	N/A	N/A
Loaf Volume, cm ³	950	855	780	835	875
Appearance	8.0	8.0	8.0	8.0	8.2
Crumb Structure	6.5-o	6.8-o	6.8-o	6.8-o	6.8-o
Crumb Color	6.5-d	6.0-d	5.8-d	6.0-d	6.2-dy
FARINOGRAM					
Absorption, %	66.1	65.6	65.1	65.3	64.9
Development Time, min	5.50	4.75	4.25	4.50	4.75
Mixing Tolerance Index, BU	25	25	30	30	30
Stability, min	12.00	11.00	9.50	9.25	8.25
EXTENSIGRAM					
Length, cm	23	22	21	23	22
Height at 5 cm, BU	285	295	285	280	260
Maximum Height, BU	495	495	475	455	430
Area, cm ²	145	145	135	145	130
ALVEOGRAM					
Length, mm	143	119	110	130	124
P (height x 1.1), mm	93	106	111	98	97
W, x 10 ³ ergs	407	399	391	400	391

* 10-yr period 1980 to 1989, except Maltose Value (7-yr mean) and Mixing Tolerance Index and Stability (5-yr means)

4. NO. 2 CANADA WESTERN RED SPRING WHEAT
Quality Data for 1991 Harvest Survey Grade Composite Samples

Quality Parameter	Minimum Protein Level		No. 2 CW 13.5	
	13.5	12.5	1990	Mean*
WHEAT				
Test Weight, kg/hL	78.8	79.1	79.4	79.7
Weight per 1000 Kernels, g	30.3	30.1	32.1	30.8
Protein Content, % (N x 5.7)	13.6	12.8	13.7	13.7
Ash Content, %	1.71	1.62	1.55	1.58
Alpha-amylase Activity, units/g	6.6	4.6	8.8	7.1
Falling Number, s	385	400	370	385
Particle Size Index, %	49.5	48.6	51.5	N/A
MILLING				
Flour Yield				
Clean Wheat Basis, %	75.2	75.4	75.4	75.0
0.50% Ash Basis, %	75.2	74.9	75.9	75.5
-0.3 Flour Color Grade Basis, %	76.7	78.1	77.2	75.6
FLOUR				
Protein Content, %	13.0	12.2	13.2	13.1
Wet Gluten Content, %	38.5	35.7	40.1	38.9
Ash Content, %	0.50	0.51	0.49	0.49
Color, units	-0.8	-1.2	-0.9	-0.5
Starch Damage, Farrand units	33	36	33	30
Alpha-amylase Activity, units/g	1.7	1.9	2.9	2.4
Amylograph Peak Viscosity, BU	630	620	540	585
Maltose Value, g/100 g	2.1	2.2	2.2	2.0
BAKING (Remix-to-Peak Method)				
Absorption, %	64	64	64	64
Remix Time, min	2.5	2.6	N/A	N/A
Loaf Volume, cm ³	860	800	825	875
Appearance	8.0	8.0	8.0	8.0
Crumb Structure	6.5-o	6.8-o	7.0-o	6.8-o
Crumb Color	6.2-d	5.8-d	6.0-d	6.2-dy
FARINOGRAM				
Absorption, %	64.7	64.3	65.4	64.6
Development Time, min	4.75	4.25	4.50	4.50
Mixing Tolerance Index, BU	30	30	35	30
Stability, min	9.75	9.00	7.75	7.75
EXTENSIGRAM				
Length, cm	22	22	23	22
Height at 5 cm, BU	290	290	260	255
Maximum Height, BU	495	490	430	405
Area, cm ²	150	150	130	125
ALVEOGRAM				
Length, mm	130	122	128	123
P (height x 1.1), mm	91	101	96	93
W, x 10 ³ ergs	381	381	374	367

* 10-yr period 1980 to 1989, except Maltose Value (7-yr mean) and Mixing Tolerance Index and Stability (5-yr means)

Milling and Baking Quality - GRL Pilot Mill

Samples of 1990 and 1991 harvest survey No. 1 CWRS 13.5 wheat were milled with the GRL pilot mill consecutively in duplicate to complement laboratory-scale milling data.

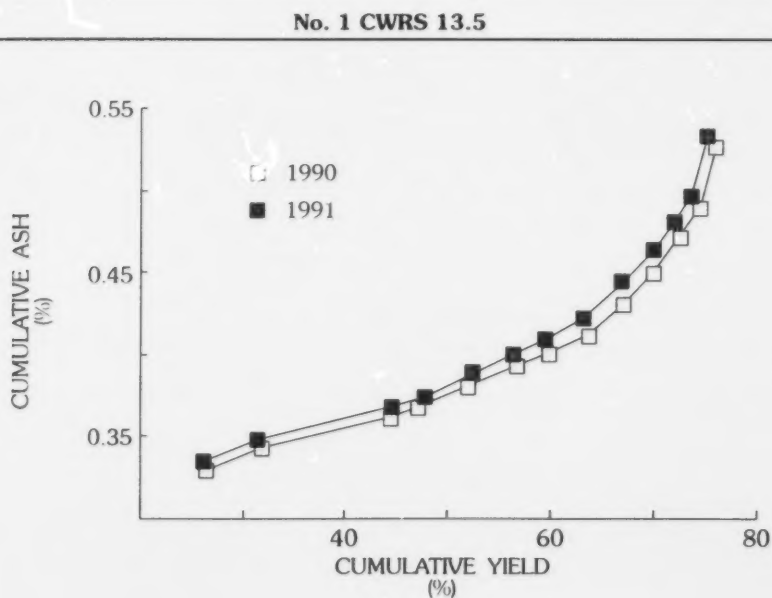
Cumulative ash curves (Figure 3) were computed from the ash content and yield of individual millstreams from each milling. A straight-grade flour and a high quality patent flour (prime quality reduction streams representing 60% of total flour) were prepared to allow comparison of wheat milling properties in a commercially relevant fashion (Table 5). The pilot mill flours were also used to evaluate the baking quality of this year's crop by a 4.5 hr sponge-and-dough procedure and the Canadian short process, a short mechanical development procedure (Table 6).

The pilot milling data are in close agreement with the Allis-Chalmers milling data. When compared directly

with the 1990 composite, the 1991 sample exhibits slightly lower flour yield. Ash content is slightly higher for the 1991 flours at all extraction rates (Figure 3), but flour color grade values are comparable. Amylograph peak viscosity values this year compare favorably with those of 1990. Flour starch damage and farinograph absorption are similar to last year. The farinograph gives some indication that dough properties may be slightly stronger this year.

Baking results for pilot-milled flours from 1991 and 1990 are remarkably similar in both the sponge-and-dough method and the Canadian short process (Table 6). Baking absorptions, mixing requirements and bread properties were comparable for both years. The oxidation requirement of this year's crop appears to be similar to that of 1990.

Figure 3. Cumulative Ash Curves for Pilot Mill Flour



5. NO. 1 CANADA WESTERN 13.5 RED SPRING WHEAT
Pilot Mill Flour Data • 1991 Harvest Survey Grade Composite Sample

Quality Parameter	Straight-grade		Patent	
	1991	1990	1991	1990
FLOUR				
Flour Yield, %	75.1	75.9	47.7	47.2
Protein Content, %	13.4	13.5	12.3	12.2
Ash Content, %	0.54	0.53	0.38	0.36
Color, units	0.6	0.6	-2.1	-2.2
Amylograph Peak Viscosity, BU	615	605	795	630
Starch Damage, Farrand units	26	26	27	29
FARINOGRAM				
Absorption, %	63.4	63.7	62.1	62.1
Development Time, min	5.00	4.75	5.25	4.75
Mixing Tolerance Index, BU	35	40	20	25
Stability, min	8.00	7.50	17.00	14.00

6. NO. 1 CANADA WESTERN 13.5 RED SPRING WHEAT
Pilot Mill Flour Baking Data • 1991 Harvest Survey Grade Composite Sample

Quality Parameter	Straight-grade		Patent	
	1991	1990	1991	1990
SPONGE-AND-DOUGH METHOD				
Potassium Bromate, ppm	20	20	20	20
Absorption, %	65	65	63	63
Mixing ¹ : energy, Whr/kg	3.0	2.9	3.6	3.4
Mixing ¹ : time, min	3.4	3.5	4.6	4.5
Loaf Volume, cm ³ /100 g flour	1 160	1 120	1 045	1 030
Yield: bread wt/flour wt	1.42	1.44	1.42	1.42
Appearance	7.9	7.7-v sl o ²	7.2	7.5
Crumb Structure	6.8-o ⁺	6.8-o ⁺	6.7-o	6.8-o
Crumb Color	7.8	7.8	8.2	8.2
CANADIAN SHORT PROCESS				
Ascorbic Acid/Bromate, ppm	37.5/30	37.5/30	37.5/30	37.5/30
Absorption, %	67	67	65	65
Mixing: energy, Whr/kg	6.1	5.6	5.8	6.5
Mixing: time, min	7.0	6.5	6.8	7.5
Loaf Volume, cm ³ /100 g flour	1 035	1 035	1 045	1 030
Yield: bread wt/flour wt	1.55	1.55	1.52	1.54
Appearance	7.2	7.4	7.4	7.5
Crumb Structure	6.7-o	6.7-o	6.8-o	6.7-o
Crumb Color	8.1	8.1	8.5	8.4

¹ dough stage

² v sl o - very slightly old

Canada Western Amber Durum Wheat

In 1991, the largest Western Canadian amber durum wheat harvest ever came in at 4.5 million tonnes - 4% higher than the record crop of 1990. Because weather conditions during harvest were very good, the bulk of the crop will qualify for the top two grades. The primary factor for downgrading samples from No. 1 to No. 2 CWAD is the incidence of piebald and starchy kernels. Other degrading factors such as smudge, frost and sprouting are insignificant this year.

The general soundness of this year's crop is reflected in good test weight and good kernel size. The high falling number values and the low alpha-amylase activity of both wheat and semolina indicate no sprouting damage. The protein content of this year's crop is over one percentage unit lower than that of 1990. This is the result of widespread and abundant rainfall, in some areas in excess of twice the normal precipitation between mid-April to mid-July. The lush growth and resultant higher than average yield led to lower protein content.

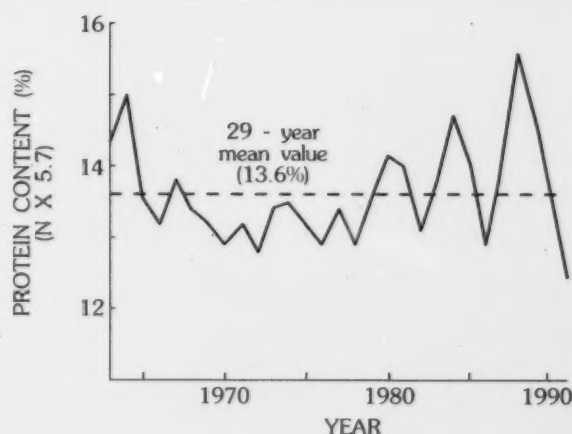
Semolina yield is higher this year by over one percentage unit for both grades. Semolina color, as expressed by AGTRON value, is slightly better than that of last year. The yellow pigment level in Canadian durum varieties is sufficient to produce spaghetti with very good, bright yellow color. In 1991, spaghetti has very good color with higher brightness values than those of 1990. Purity values are about the same.

Despite the lower protein content this year, the cooking quality is acceptable, although the CQP values are lower than in 1990. The lower protein content is

also reflected in lower SDS sedimentation values, which in a normal year are about 45 mL. The lower sedimentation values are not an indication of a change in durum varieties. Kyle was again the predominant variety grown.

Sprouting damage was not a significant degrading factor this year. As of August 1, 1991, the tolerance for sprouted kernels has been tightened for the top two grades: to 0.5% from 1.0% for No. 1 CWAD and to 2.0% from 5.0% for No. 2 CWAD. Should sprouting be encountered in future years, the new tolerances will ensure high falling number values for the top two grades.

Figure 4. Mean Protein Content of Harvest Survey Western Canadian Amber Durum Wheat 1963 to 1991



7. Protein Content of 1991 Harvest Survey Canada Western Amber Durum Wheat

Grade	Protein Content (%)*					
	Western Canada			1991		
	1991	1990	1981-90	Manitoba	Saskatchewan	Alberta
No. 1 CWAD	12.7	14.1	14.2	12.2	12.5	13.1
No. 2 CWAD	12.2	13.7	14.0	12.4	11.8	12.9

* N x 5.7; 13.5% moisture content basis.

8. NO. 1 AND NO. 2 CANADA WESTERN AMBER DURUM WHEAT
Quality Data for 1991 Harvest Survey Grade Composite Samples

Quality Parameter	1991		1990	
	No. 1 CWAD	No. 2 CWAD	No. 1 CWAD	No. 2 CWAD
WHEAT				
Test Weight, kg/hL	81.9	81.0	81.4	80.9
Weight per 1000 Kernels, g	42.1	41.2	42.8	42.0
Vitreous Kernels, %	85	77	92	86
Protein Content, %	12.6	12.3	14.1	13.7
Ash Content, %	1.62	1.65	1.53	1.58
SDS Sedimentation, mL	32	32	43	40
Falling Number, s	420	395	385	355
Alpha-amylase Activity, units/g	4.5	7.5	5.5	12.4
Milling Yield, %	74.5	73.7	75.9	74.9
Semolina Yield, %	65.5	64.4	63.8	63.2
SEMOLINA				
Protein Content, %	11.8	11.5	13.3	12.8
Wet Glute., Content, %	32.5	31.5	35.6	34.5
Ash Content, %	0.69	0.71	0.69	0.70
AGTRON Color, units	77	79	74	75
Speck Count per 50 cm ²	33	34	23	25
Alpha-amylase Activity, units/g	0.9	2.4	2.1	7.9
SPAGHETTI				
Dried at 70°C				
Color:				
Brightness, %	51.5	51.6	49.7	50.1
Purity, %	49.8	49.7	50.2	50.2
Dominant Wavelength, nm	576.7	576.6	576.9	577.0
Cooking Quality, CQP	46.2	39.4	55.9	59.3
Cooking Loss, %	5.5	5.7	5.7	5.7

Canada Western Red Winter Wheat

Canada Western Red Winter (CWRW) wheat has excellent milling quality. Flour produced from high grade CWRW wheat performs well in the production of hearth breads and certain types of noodles, and is also suitable for the production of various types of flat bread, steamed bread and related products.

The variety Norstar continues to account for the major portion of the area seeded to CWRW wheat, with Norwin also being grown.

As indicated in Table 9, the average protein content for the No. 1 CW grade is 11.1% this year, 0.6 percentage units lower than in 1990. The No. 2 CW grade, at 10.3% protein, is also 0.6 percentage units lower than last year.

Quality data for composites representing the top two grades, as well as comparative data from 1990, are provided in Table 10. Test weight for the No. 1 grade is similar, and for the No. 2 grade somewhat higher - compared with corresponding 1990 values. Kernel weight is higher for this year's crop. The high wheat

falling number and flour amylograph peak viscosity values of the top grade are consistent with the low levels of alpha-amylase activity present.

Both grades exhibit excellent milling quality, with high flour yield and very low flour ash and flour color values. This year's crop shows weaker physical dough properties and lower loaf volumes compared with last year. These differences can be attributed mainly to the reduction in protein content for 1991.

**9. Protein Content of 1991 Harvest Survey
Canada Western Red Winter Wheat**

Grade	Protein Content (%)*	
	1991	1990
No. 1 CWRW	11.1	11.7
No. 2 CWRW	10.3	10.9

* N x 5.7; 13.5% moisture content basis.

10. CANADA WESTERN RED WINTER WHEAT
Quality Data for 1991 Harvest Survey Grade Composite Samples

Quality Parameter	1991		1990	
	No. 1 CW	No. 2 CW	No. 1 CW	No. 2 CW
WHEAT				
Test Weight, kg/hL	82.1	81.4	82.0	80.8
Weight per 1000 Kernels, g	32.0	32.4	30.0	29.3
Protein Content, % (N x 5.7)	11.2	10.3	11.7	10.9
Ash Content, %	1.39	1.53	1.31	1.50
Alpha-amylase Activity, units/g	6.3	13.2	8.3	14.1
Falling Number, s	375	320	370	325
Particle Size Index, %	54.0	55.0	52.6	56.5
Flour Yield, %	76.5	76.7	75.8	75.2
FLOUR				
Protein Content, %	10.5	9.5	11.2	10.3
Wet Gluten Content, %	29.9	27.7	32.2	30.0
Ash Content, %	0.44	0.44	0.44	0.46
Color, units	-1.4	-1.7	-1.4	-1.5
Starch Damage, Farrand units	26	25	24	21
Alpha-amylase Activity, units/g	4.0	9.0	3.0	4.2
Amylograph Peak Viscosity, BU	410	225	475	420
Maltose Value, g/100 g	2.1	2.2	1.8	1.7
BAKING (Remix-to-Peak Method)				
Absorption, %	58	56	58	56
Remix Time, min	2.3	1.9	N/A	N/A
Loaf Volume, cm ³	730	670	745	695
Appearance	8.0	7.8	8.0	7.8
Crumb Structure	6.5-o	6.5-o	7.0-o	6.8-o
Crumb Color	5.8-d	5.5-d	6.5-d	5.8-d
FARINOGRAM				
Absorption, %	58.0	55.6	57.6	56.1
Development Time, min	5.00	5.00	5.25	4.50
Mixing Tolerance Index, BU	60	50	40	45
Stability, min	7.50	7.00	9.50	8.50
EXTENSIGRAM				
Length, cm	23	22	23	23
Height at 5 cm, BU	280	250	295	260
Maximum Height, BU	480	395	545	455
Area, cm ²	145	115	165	140
ALVEOGRAM				
Length, mm	177	161	156	172
P (height x 1.1), mm	57	54	62	50
W, x 10 ³ ergs	284	252	313	252

Canada Prairie Spring Wheat

The Canada Prairie Spring (CPS) class is divided into two categories: CPS-Red (CPS-R) which includes red seed coated varieties, and CPS-White (CPS-W) which includes white seed coated varieties. Two grades are available for each CPS type. The predominant variety for CPS-R is Biggar and for CPS-W is Genesis. Both were released to producers in 1989 and this is the first year that harvest survey quality testing information is being published for these new wheats.

Wheat of the CPS-R type is suitable for the production of hearth breads and can also be used alone or in blends for the production of noodles, flat breads, pan breads, crackers and related products. Canada Prairie Spring - White wheat is suitable for various types of noodles and flat breads, as well as for chapattis and crackers.

Quality data for the No. 1 grade composites, both red and white, are given in Table 11. Protein content of CPS-R is 11.2% and of CPS-W is 10.8%. These values are lower than the normally expected range of 11.5 to 12.0% for this class of wheat. Both composites have high falling number and flour amylograph peak viscosity values, consistent with the dry harvesting conditions in 1991.

Good milling performance was achieved, with the CPS-W sample having better flour ash and color values. The CPS-R flour had weaker dough properties than normal, attributable to the low protein content this year. The CPS-W flour had typical dough properties for this class of wheat, including a farinograph dough development time of 2.75 minutes. Superior baking quality was exhibited, as expected, by the CPS-R composite.

11. CANADA PRAIRIE SPRING WHEAT

Quality Data for 1991 Harvest Survey Grade Composite Samples

Quality Parameter	No. 1 CPS - Red	No. 1 CPS - White
WHEAT		
Test Weight, kg/hL	79.7	80.9
Weight per 1000 Kernels, g	32.6	33.4
Protein Content, % (N x 5.7)	11.2	10.8
Ash Content, %	1.55	1.59
Alpha-amylase Activity, units/g	1.5	3.5
Falling Number, s	390	405
Particle Size Index, %	53.8	57.2
Flour Yield, %	74.6	75.4
FLOUR		
Protein Content, %	10.4	10.0
Wet Gluten Content, %	31.3	30.7
Ash Content, %	0.54	0.49
Color, units	-0.3	-1.2
Starch Damage, Farrand units	24	21
Alpha-amylase Activity, units/g	0.5	1.5
Amylograph Peak Viscosity, BU	805	740
Maltose Value, g/100 g	1.6	1.6
BAKING (Remix-to-Peak Method)		
Absorption, %	57	57
Remix time, min	1.0	0.9
Loaf Volume, cm ³	685	610
Appearance	6.0	5.5
Crumb Structure	6.0-o	6.2-o
Crumb Color	5.5-d	5.2-d
FARINOGRAM		
Absorption, %	57.9	58.8
Development Time min	3.25	2.75
Mixing Tolerance Index, BU	60	80
Stability, min	5.50	3.50
EXTENSIGRAM		
Length, cm	25	23
Height at 5 cm, BU	215	200
Maximum Height, BU	320	270
Area, cm ²	110	90
ALVEOGRAM		
Length, mm	182	160
P (height x 1.1), mm	50	56
W, x 10 ³ ergs	205	183

Canada Western Utility Wheat

Canada Western Utility (CWU) wheat is characterized by its hard kernel texture and very strong physical dough properties. This wheat is excellent for blending purposes and can also be used for the production of pan breads, hearth breads and common wheat pasta products.

Protein content for this year's No. 1 CWU grade wheat averaged 12.8%, which is slightly higher than last year. The predominant variety entering this class for 1991 was Glenlea.

Quality data for the No. 1 CWU grade composite are shown in Table 12. High wheat falling number and flour amylograph peak viscosity values are consistent

with the low levels of alpha-amylase, indicating very sound kernels. Milling properties show the higher flour yield and flour ash content typical of this class of wheat. Flour color is very good and the high starch damage is consistent with the hard kernel texture of CWU wheat.

Due to very strong properties, dough made from CWU wheat flour cannot be properly developed at the normal farinograph speed of 63 rpm. When operated at 90 rpm, the farinograph showed dough consistency maxima at 2.00 and 8.50 minutes. Test baking results show the very good bread quality that can be attained when sufficient mixing and fermentation is imparted to obtain optimum dough development.

12. NO. 1 CANADA WESTERN UTILITY WHEAT**Quality Data for 1991 Harvest Survey Grade Composite Sample**

Quality Parameter	1991	1990
WHEAT		
Test Weight, kg/hL	78.5	78.8
Weight per 1000 Kernels, g	38.5	39.1
Protein Content, % (N x 5.7)	12.8	12.7
Ash Content, %	1.71	1.58
Alpha-amylase Activity, units/g	4.7	6.7
Falling Number, s	390	365
Particle Size Index, %	43.9	43.5
Flour Yield, %	75.8	75.9
FLOUR		
Protein Content, %	12.1	12.1
Wet Gluten Content, %	31.7	30.5
Ash Content, %	0.58	0.57
Color, units	-0.2	-0.5
Starch Damage, Farrand units	45	40
Alpha-amylase Activity, units/g	1.0	2.3
Amylograph Peak Viscosity, BU	615	605
Maltose Value, g/100 g	2.8	2.6
BAKING (Remix-to-Peak Method)		
Absorption, %	63	63
Remix time, min	3.8	4.2
Loaf Volume, cm ³	880	795
Appearance	8.5	8.2
Crumb Structure	7.5	7.0-o
Crumb Color	8.2	7.8
FARINOGRAM		
Absorption, %	61.6	62.1
Development Time (90 rpm), min	8.50	10.00
EXTENSIGRAM		
Length, cm	25	25
Height at 5 cm, BU	345	360
Maximum Height, BU	685	715
Area, cm ²	235	245
ALVEOGRAM		
Length, mm	96	111
P (height x 1.1), mm	120	120
W, x 10 ³ ergs	448	525

Canada Western Soft White Spring Wheat

Canada Western Soft White Spring (CWSWS) wheat is a lower protein, soft wheat with weak dough properties. Flours milled from this wheat are suitable for the production of cookies, cakes, biscuits and related products. They can also be used alone or in blends with stronger wheat flours for the production of crackers, flat breads, steamed breads and certain types of noodles.

Wheat of this class is grown under irrigation to maximize yield and minimize protein content. Mean overall protein content for 1991 is 10.6%, which is lower than in 1990 and 1989. Table 13 outlines protein content of the top two grades for a three-year period. The predominant variety was again Fielder, with a small amount of Owens also grown.

Quality data for the two composites and comparative results for 1990 are provided in Table 14. Values for

test weight, kernel weight and falling number are lower than in 1990. Milling properties of the No. 1 CWSWS grade composite are similar to those of last year, although flour yields are somewhat lower. Farinograph and alveograph data indicate that the 1991 flours have similar dough properties to those of 1990.

**13. Protein Content of 1991 Harvest Survey
Canada Western Soft White Spring Wheat**

Grade	Protein Content (%) [*]		
	1991	1990	1989
No. 1 CWSWS	10.6	10.8	10.9
No. 2 CWSWS	10.7	11.1	11.0

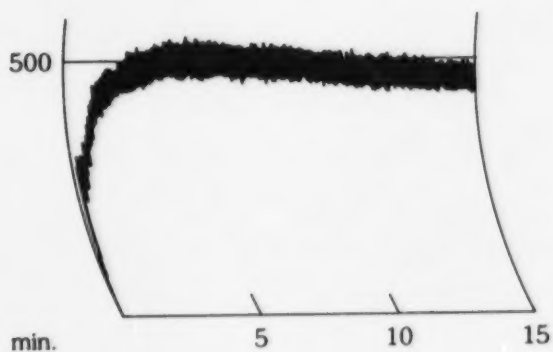
^{*} N x 5.7; 13.5% moisture content basis.

14. CANADA WESTERN SOFT WHITE SPRING WHEAT
Quality Data for 1991 Harvest Survey Grade Composite Samples

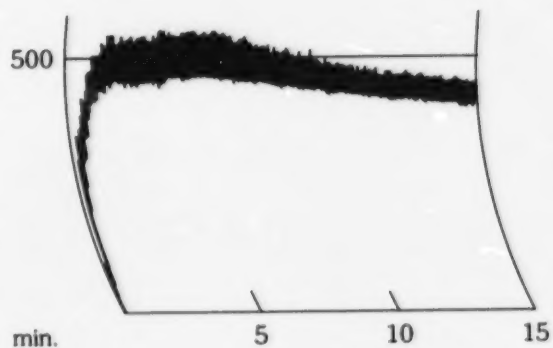
Quality Parameter	1991		1990	
	No. 1 CWSWS	No. 2 CWSWS	No. 1 CWSWS	No. 2 CWSWS
WHEAT				
Test Weight, kg/hL	81.0	80.1	81.7	80.6
Weight per 1000 Kernels, g	35.4	34.6	36.2	35.4
Protein Content, % (N x 5.7)	10.8	10.8	10.9	11.2
Ash Content, %	1.55	1.58	1.48	1.59
Alpha-amylase Activity, units/g	12.6	17.5	7.5	22.4
Falling Number, s	310	285	355	290
Particle Size Index, %	67.6	65.9	67.1	67.2
Flour Yield, %	73.4	72.6	74.0	73.3
FLOUR				
Protein Content, %	9.3	9.4	9.8	10.1
Wet Gluten Content, %	32.2	33.6	28.9	32.6
Ash Content, %	0.46	0.45	0.46	0.46
Color, units	0.0	0.0	-0.2	-0.2
Starch Damage, Farrand units	11	9	8	8
Alpha-amylase Activity, units/g	4.0	6.0	2.0	6.1
Amylograph Peak Viscosity, BU	665	470	810	470
Maltose Value, g/100 g	1.2	1.2	1.0	1.1
FARINOGRAM				
Absorption, %	54.8	55.0	55.3	55.1
Development Time, min	1.25	1.25	1.25	1.25
Mixing Tolerance Index, BU	195	190	185	200
Stability, min	1.50	1.00	1.50	1.00
ALVEOGRAM				
Length, mm	97	117	142	137
P (height x 1.1), mm	24	23	23	22
W, x 10 ³ ergs	37	44	33	38

Figure 5. Farinograms of 1991 Crop Composite Samples

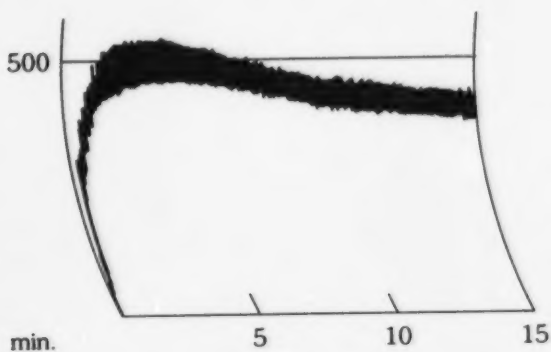
No. 1 Canada Western 13.5 Red Spring Wheat



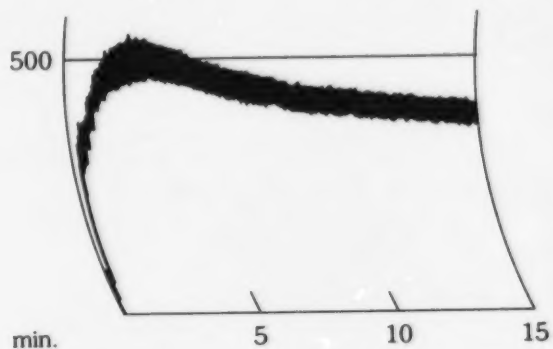
No. 1 Canada Western Red Winter Wheat



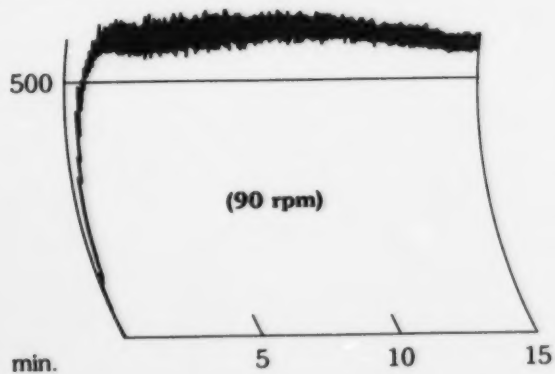
No. 1 Canada Prairie Spring Wheat - Red



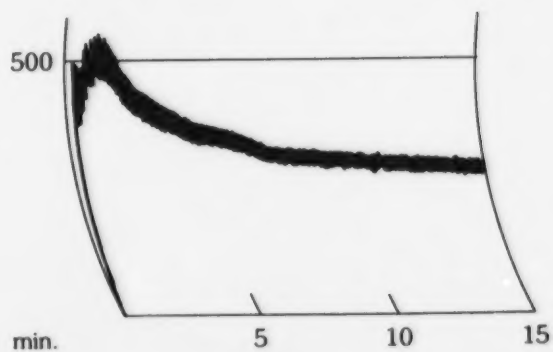
No. 1 Canada Prairie Spring Wheat - White



No. 1 Canada Western Utility Wheat



No. 1 Canada Western Soft White Spring Wheat



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Methods

Notes on the methods used at the Grain Research Laboratory are given below. Unless otherwise specified, analytical results for wheat are reported on a 13.5% moisture basis and for flour on a 14.0% moisture basis. The AACC methods cited are those of the American Association of Cereal Chemists given in *Cereal Laboratory Methods*, Eighth Edition, 1983. The ICC methods are those of the International Association for Cereal Science and Technology.

Test Weight is determined using the Schopper Chondrometer equipped with the 1 litre container. The weight in grams of the measured litre of wheat is divided by 10 and the result is reported on an "as is" moisture content basis.

Weight per Thousand Kernels. Broken kernels and foreign material are first removed from a sample by hand-picking. The number of kernels in a 20 g sub-sample of this cleaned material is then counted using an electronic seed counter.

Protein Content (N x 5.7) is determined by the Kjeldahl method as modified by Williams, "Journal of the Science of Food and Agriculture" 24:343, 1973.

Alpha-amylase Activity of wheat and of flour is determined by the method of Kruger and Tipples, "Cereal Chemistry" 58:271-274, 1981.

Falling Number is determined on a 7 g sample of ground wheat by the method of Hagberg, "Cereal Chemistry" 38:202-203, 1961. Wheat (300 g) is ground in a Falling Number Laboratory Mill 3100 (ICC Standard Method No. 107). Results are reported on a 14.0% moisture content basis.

Particle Size Index (PSI) is determined according to Williams and Sobering, "Cereal Foods World" 31:417-420, 1986. PSI is an indication of the relative kernel texture (hardness or softness) of different wheat types. Soft wheats give high PSI values of 65 to 75; durum wheats give low values of 35 to 45; and all other wheat types give intermediate values.

Milling (flour). Wheat is cleaned, scoured and tempered overnight to optimum moisture as described by Dexter and Tipples, "Milling" 180(7):16, 1987. Milling of common wheat is then carried out in an Allis-Chalmers laboratory mill using the GRL sifter flow as described by Black *et al.*, "Cereal Foods World" 25:757-760, 1980. Flour yield is expressed as a percentage of cleaned wheat on a constant moisture basis, and for CWRS wheat, is also expressed on a constant ash content basis and constant flour color

grade basis computed as described by Dexter and Tipples, "Milling" 182(8):9-11, 1989. Pilot milling (flour) is carried out as described by Black, "Bulletin - Association of Operative Millers", 3834, 1980.

Wet Gluten Content. The ICC Standard Method No. 137 is followed using the "Glutomatic" System.

Ash Content is determined on a 4 g sample in a silica dish incinerated overnight at 600°C. After cooling, the dish plus ash are weighed, the ash brushed out, the dish reweighed, and the weight of ash determined by difference.

Flour Color. A color index is obtained using the automated Simon Series IV Flour Color Grader which gives the relative reflectance of a flour-water slurry. Results are reported as arbitrary scale units; the lower the number, the brighter the color.

Starch Damage is determined on a 5 g sample by the method of Farrand, "Cereal Chemistry" 41:98-111, 1964.

Amylogram. Sixty-five grams of flour (14.0% moisture content basis) and 450 mL distilled water are used with the Brabender Amylograph and the pin stirrer; other details are as in AACC Method 22-10. Peak viscosity is reported in Brabender units.

Maltose Value is determined according to AACC Method 22-16.

Farinogram. Fifty grams of flour (14.0% moisture content basis) are mixed in a small stainless steel farinograph bowl (63 r.p.m. drive) for 15 min. with sufficient distilled water to give a maximum dough consistency centered about the 500 Brabender Unit line. Farinograph absorption is the amount of water which must be added to a flour of 14.0% moisture content to give the required consistency, and is reported as percent. Dough development time is the time required for the curve to reach its maximum height. For additional details, see the *Farinograph Handbook*, AACC, 1960.

Extensigram. Doughs are made from 300 g flour (14.0% moisture content basis), 6 g salt, and distilled water equal to the farinograph absorption less 2.0 percentage units to compensate both for the salt and for the substitution of the large stainless steel farinograph bowl. Doughs are mixed for 1 min., rested for 5 min., and mixing is then continued until the curve is centered about the 500 Brabender Unit line. Curves are drawn for duplicate doughs at 45 and at 135 min. though doughs are also rounded and shaped at 90 min. Average curves for 45 and 135 min. are reproduced, but measurements (length in centimeters, height in Brabender Units, and area in square centimeters) are reported only for the 135 min. curve (solid line). The Extensigraph is set so that 100 Brabender Units equal a 100 g load.

Alveogram. The ICC Standard Method No. 121 is followed, using the constant pressure Model MA82 instrument.

Remix-to Peak Baking Test is a modification of the Remix baking test procedure of Irvine and McMullan, "Cereal Chemistry" 37:603-613, 1960, as described in detail by Kilborn and Tipples, "Cereal Foods World" 26:624-628, 1981. Dough is mixed to optimum (peak) consistency at the second mixing stage.

Sponge-and-Dough Baking Test. This method is based on a 4.5 hr. 70% sponge system as described by Kilborn and Preston, "Cereal Chemistry" 58:198-201, 1981.

Canadian Short Process Baking Test is carried out as described by Preston *et al*, "Canadian Institute of Food Science and Technology Journal" 15:29-36, 1982. For this method and for the sponge-and-dough procedure, loaves are produced from 200 g of flour in baking pans that have cross-section dimensions similar to those of Canadian commercial baking pans. Preliminary baking tests are carried out to determine optimum oxidation requirements.

Vitreous Kernels. This determination is made by the Grain Inspection Division on a 25 g sample of clean wheat. The vitreous kernels are handpicked and weighed.

SDS Sedimentation values are determined by the method of Axford and Redman, "Cereal Chemistry" 56:582 (1979), using 3% SDS.

Milling (semolina). Wheat is cleaned, scoured and tempered overnight to 16.5% moisture as described by Dexter and Tipples, "Milling" 180(7):16, 1987. An Allis-Chalmers mill in conjunction with a laboratory purifier (Black, "Cereal Science Today" 11:533, 1966) is used for milling as described by Dexter *et al*, "Cereal Chemistry" 67:405, 1990. Milling yield (including flour) and semolina yield (less than 1% through a 149 micron sieve) are reported, on a constant moisture basis, as a percentage of the cleaned wheat. The millroom is controlled for temperature (22°C) and humidity (60%).

Semolina Color is determined according to AACC Method 14-30. An AGTRON direct reading reflectance spectrophotometer is used.

Speck Count is determined as described by Dexter and Matsuo, "Cereal Chemistry" 59:63 (1982).

Spaghetti is processed from semolina on a DEMACO laboratory-scale continuous extrusion press as described by Matsuo *et al* "Cereal Chemistry" 55:744 (1978) and dried both by a conventional low-temperature drying cycle (39°C) and by a high-temperature cycle (70°C) as described by Dexter *et al* "Journal of Food Science" 46:1741 (1981).

Spaghetti Color. Whole strands of spaghetti are mounted on white cardboard for color measurements. Dominant wavelength, purity and brightness are determined, using the Ten Selected Ordinates method, with a Beckman DU-7 Spectrophotometer.

Spaghetti Cooking Quality is determined according to the method of Dexter and Matsuo, "Canadian Journal of Plant Science" 57:717-727, 1977.

Cooking Loss, the amount of material lost in the cooking water, is determined as described by Dexter and Matsuo, "Cereal Chemistry" 56:394, 1979.

Farinogram (semolina). Fifty grams of semolina (14.0% moisture content basis) is mixed with distilled water (31.5% absorption) in the small stainless steel farinograph bowl (59 r.p.m. drive), using the rear sensitivity setting.

Collection of Samples. Samples are obtained from producers and from grain companies operating primary elevators in Western Canada. Samples collected up to and including the following dates were used for 1991:

- September 25 - No. 1 CW Red Spring Wheat
- September 26 - No. 1 and No. 2 CW Amber Durum Wheat
- September 27 - No. 1 CW Utility Wheat
- October 4 - No. 2 CW Red Spring Wheat
 - No. 1 and No. 2 CW Red Winter Wheat
- October 7 - No. 1 Canada Prairie Spring Wheat
- October 8 - No. 1 and No. 2 CW Soft White Spring Wheat

Acknowledgements

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